

Another observer, writing from Prestwich to the *Manchester Examiner and Times*, describes it as having moved from S.S.E. to N.N.W., passing a few degrees to the east of the zenith, and exploding and then vanishing at an angle (altitude) of 40° to 45° .

At Tarporley it was visible for thirty seconds, moving from E. to N.N.W.

The same fire-ball was also seen in Cheshire.

Stonyhurst Observatory, Whalley, May 31 S. J. PERRY

ON May 16, about 11 p.m., I saw a meteor that was, I think, the most terrific, as well as the grandest, I have ever happened to see. I reached my house about ten minutes afterwards, and at once wrote down, substantially, the following unvarnished account of the phenomenon. It may have been witnessed and recorded by some one elsewhere. If so, the observer may like to compare my record of it with his own:—I was walking westward, and I was about two miles south-west of Woodstock (as the crow flies). Suddenly my attention was drawn upward by a brilliant light. I then saw a meteor high up in the western sky, and a little south of the Great Bear. It was descending at an angle of 50° . Its speed was so moderate, that I got a good observation of it. Its seeming size was, I think, quite half that of the full moon. Its appearance was such as I never saw before: it struck me as being like a transparent lantern, or, rather, pail, full of burning matter. Its base was a sharply-defined broad cone. It looked as though let down from above by an unseen string, rather than falling. It seemed to be very near me. A flickering reddish flame rose, fitfully, straight up from the horizontal surface of its yellow-hued fiery mass. It vanished, without my seeing any scattering of sparks, when it was about half way between the Pointers and the horizon.

JOHN HOSKYNs-ABRAHAM

Combe Vicarage, near Woodstock, May 27

Earth-Tremors in Japan

AN article on earth-tremors, which appeared in the *Times* last November, seems to have attracted considerable attention in Japan, and a few facts respecting the work which has been attempted in the investigation of microseismic disturbances in this country, may possibly be of interest. In the *Transactions* of the Seismological Society of Japan we have already had three communications on this subject. Prof. H. M. Paul told us how, when searching for a site for the United States Naval Observatory at Washington, by watching the reflection of the image of a star in a vessel of mercury with a telescope, he was easily enabled to detect earth-tremors produced by a railway train at the distance of a mile.

Major H. S. Palmer, R.E., of Hong Kong, gave us an account of how, by digging a trench large enough to contain himself and his instruments when seeking for a station from which to make observations on the Transit of Venus, he practically escaped from earth-tremors which emanated from a railway line about 400 yards distant. As there are strong reasons for believing that many of the earthquakes which are felt in Yedo are produced by the faulting of the rocks, it was natural to assume that before the actual breakage took place there might be a crackling or gradual giving way which would be indicated to us by preceding earth-tremors.

In order to determine the presence of these earth-tremors, at the end of 1879 I commenced a series of experiments with a variety of apparatus, amongst which were microphones and sets of pendulum apparatus, very similar in general arrangement, but, unfortunately, not in refinement of construction, to the arrangements now being used in the Cavendish Laboratory.

The microphones were screwed on to the heads of stakes driven in the ground, at the bottom of boxed-in pits. In order to be certain that the records which these microphones gave were not due to local actions, such as birds or insects, two distinct sets of apparatus were used, one being in the middle of the lawn in the front of my house, and the other in a pit at the back of the house. The sensitiveness of these may be learnt from the fact that if a small pebble was dropped on the grass within six feet of the pit, a distinct sound was heard in the telephone, and a swing produced in the needle of the galvanometer placed in connection with these microphones. A person running or walking in the neighbourhood of the pits, had each of his steps so definitely recorded, that a Japanese neighbour, Mr. Masato, who assisted me in the experiments, caused the swinging needle of his galvanometer to close an electric circuit and ring a bell,

which, it is needless to say, would alarm a household. In this contrivance we have a hint as to how earth-tremors may be employed as thief-detectors.

The pendulum apparatus, one of which consisted of a 20 lb. bob of lead at the end of 20 feet of pianoforte wire provided with small galvanometer mirrors, and bifilar suspensions were also used in pairs. With this apparatus a motion of the bob relatively to the earth was magnified 1000 times, that is to say, if the spot of light which was reflected from the mirror moved a distance equal to the thickness of a sixpence, this indicated there had been a relative motion of the bob to the extent of 1000th part of that amount.

The great evil which every one has to contend with in Japan when working with delicate apparatus are the actual earthquakes, which stop or alter the rate of ordinary clocks.

Another evil which had to be contended with was the wind, which shook the house in which my pendulums were supported, and I imagine the ground by the motion of some neighbouring trees. A shower of rain also was not without its effects upon the microphones. After many months of tiresome observation, and eliminating all motions which by any possibility have been produced by local influence, the general result obtained was that there were movements to be detected every day and sometimes many times per day.

Although these observations, which I found required more attention than a private observer was enabled to give to them, have been discontinued, I sincerely hope they may be again taken up. My reason for this is that in a country like Japan, where earthquakes are in some part or other phenomena of everyday occurrence, we have excellent opportunities of determining whether any connection exists between earthquakes and earth-tremors. The idea that earth-tremors may be the forerunners of earthquakes is by no means novel, and that earth-tremors actually exist was demonstrated some years ago in Florence by Timoleo Bartelli, who made microscopic observations of the pointer of a pendulum, which, to free from local surface action, he suspended in a cell. The localities which I should recommend for the observations of earth-tremors would be as near as possible to some earthquake centre. The localisation of these centres, however, is a matter of some difficulty. The difficulty arises from the fact that good time observations on earthquakes have, so far as I am aware, never yet been obtained; and farther, although we are able with our seismographs to write down the direction in which the earthquakes shake us backwards and forwards, these directions by no means always tell us the direction in which an earthquake came, an east and west motion having sometimes been proved to have travelled broadside on up from the south.

A great assistance to the interpretation of the various records which an earthquake gives us on our seismographs is what I may call a barricade of post-cards. At the present moment Yedo is barricaded, all the towns around for a distance of one hundred miles being provided with post-cards. Every one of them is posted with a statement of the shocks which have been felt.

For the months of October and November it was found from the records of the post cards that nearly all the shocks came from the north and passed Yedo to the south-west. When coming in contact with a high range of mountains, they were suddenly stopped, as was inferred from the fact that the towns beyond this range did not perceive that an earthquake had occurred. This fact having been obtained, the barricade of post-cards has been extended to towns lying still farther north. The result of this has been that several earthquake origins have, so to speak, been surrounded or coralled, whilst others have been traced as far as the seashore. For the latter shocks earthquake hunting with post-cards has had to cease, and we have solely to rely upon our instruments. Having obtained our earthquake centres, at one or more of these our tremor instruments might be erected, and it would soon be known whether an observation of earth-tremors would tell us about the coming of an earthquake as the cracklings of a bending do about its approaching breakage. To render these experiments more complete, and to determine the existence of a terrain tide, a gravimeter might be established. I mention this because if terrain tides exist, and they are sufficiently great from a geological point of view, it would seem that they might be more pronounced and therefore easier to measure in a country like Japan, resting in a heated and perhaps plastic bed, than in a country like England, where volcanic activity has so long ceased, and the rocks are, comparatively speaking, cold and rigid, if an instrument sufficiently

delicate to detect differences in the force of gravity in consequence of our being lifted farther from the centre of the earth every time by the terrain tide as it passed between our feet, could be established in conjunction with the experiments on earth-tremors.

JOHN MILNE

Imperial College of Engineering, Tokio, Japan

Limulus

CONCERNING the systematic place of *Limulus*, I should like to draw attention to a habit which has, as far as I know, never been alluded to in discussions, viz. the manner of casting its skin, mentioned by me in *Deformation of Insects (Mem. Compar. Zoology)*. *Limulus* splits the skin exactly around the front margin of the head. Among Crustacea the Decapods at least split the skin around the hind margin of the carapace. Insects split the skin in the longitudinal middle line of the occiput and thorax, with the later addition of a transversal split on the head. I have seen cast skins of Scorpio, Pseudoscorpions, Hydrachna, and Arachnids, but they are not now at hand for a sure verification. As far as I remember all of them split the skin in the middle line of the anterior parts. At least I do not remember to have seen any transversal anterior split.

H. A. HAGEN

Cambridge, Mass.

The Utilisation of Ants in Horticulture

DR. C. J. MACGOWAN has sent me from Han Chow, Province of Hainan, China, a little paper on the "Utilisation of Ants as Insect Destroyers in China." It seems that in many parts of the province of Canton the orange trees are injured by certain worms, and to rid themselves from these pests, the inhabitants import ants from the neighbouring hills. The hill-people throughout the summer and winter find the nests of two species of ants, red and yellow, suspended from the branches of various trees. The "orange ant breeders" are provided with pig or goat bladders baited inside with larid. The orifices of these they apply to the entrance of the bag-like nests, when the ants enter the bladders, and, as Dr. Macgowan expresses it, "become a marketable commodity at the orangeries." The trees are colonised by placing the ants on their upper branches, and bamboo rods are stretched between the different trees, so as to give the ants easy access to the whole orchard. This remedy has been in constant use at least since 1640, and probably dates from a much earlier period. This is certainly a new way of utilising ants, which as a rule are deservedly considered a nuisance by the horticulturist. I should like to learn from any entomological reader of NATURE whether the facts communicated have before been known in Europe, and, if so, whether the species of ant has been determined.

C. V. RILEY

Washington, D.C.

Aurora Australis

APRIL 17.—Evening very dark; air close and sultry; thermometer at 65. About 6.35 p.m. noticed a broad sheath of dull rosy red in the south, stretching upwards towards the zenith; from south-east to south was spread a bright greenish-yellow glare, sufficiently luminous to enable us to read the figures of a lady's small watch. Shortly afterwards, the sky from east-by-south to south-south-west was illumined with a ruddy glow deepening to dark red; at the most easterly point of the auroral light were broad pulsating streamers of great brilliancy; these extended to south-east-by-east. Could not detect the slightest sound from aurora. Weather continued fine. April 20.—This evening there was a wide-spread glare of auroral light, with greater range, but of far less brilliancy than marked the grand display on the 17th. Weather fine and clear.

T. H. POTTS

Ohinitaki, N.Z., April 21

"Cuprous Chloride Cell"

As the account given of my cuprous chloride cell in your report (NATURE, vol. xxvi. p. 96) of the Proceedings of the Royal Society of Edinburgh is rather misleading, I hope I may be excused if I make a few remarks on the subject. It is there stated that my cells suffered greatly from loss. This is not a correct statement. There are two ways in which the work expended in charging a secondary battery is lost. When a secondary battery is being charged, the E.M.F. between the terminals of the battery is higher than the normal E.M.F. of the

battery with open terminals, work being expended in heating the cells. When the charged cells are used to supply a current, the E.M.F. between the terminals is lower than the normal E.M.F. with open terminals, work being again spent in heating the cells. This source of loss is unavoidable, and is a practice very serious. I need only refer to the recent experiments in Paris with Faure accumulators, which were, I think, reported in NATURE. The second source of loss is the local action in the cell. This depends upon the chemistry of the cell. I have found the estimation of loss from this cause a difficult matter, but I think I am justified in saying that the loss from this cause in my cell is very small, when it is properly constructed. In fact, when used as a primary, its advantage is that it does not suffer from diffusion and consequent local action as all double-fluid cells do. I think it deserves a trial as a primary battery on this account. It is necessary to protect the cuprous chloride from air, covering it with water being quite sufficient. If this is done it should be a very durable form of cell.

A. P. LAURIE

King's College, Cambridge

[The statement that the cells suffered greatly from loss is in our report coupled with an additional statement which implies that other secondary cells have the same fault; so that Mr. Laurie is in no worse predicament than other inventors of secondary batteries. Unless Mr. Laurie's cell is in this respect superior to others, the report can hardly be regarded as misleading.—Ed.]

Physico-chemical Lecture Experiments

A VERY striking lecture experiment, which I have never seen performed or described, and which illustrates the reaction, by double elective affinity, of *dry solids*, is the trituration together in a mortar of corrosive sublimate and iodide of potassium. The result is a brilliant scarlet coloration of iodide of mercury. If a large crystal of the one is rubbed on a crystal of the other, a scarlet precipitate (if the word may be so applied) is formed at every point of contact. From the brilliancy of the colour the experiment may be readily seen by a large number of spectators.

June 5

LEIGH CLIFFORD

CUPS AND CIRCLES

AN important addition to the literature of "Cups and Circles" and Cup-marked Stones,¹ has just been issued as part of the fifth volume of "Contributions to North American Ethnology," printed by the Department of the Interior in their series of the publications of the U.S. Geographical and Geological Survey of the Rocky Mountain Region. The literature of the subject as regards the Old World is already extensive, and the object of Mr. Rau's work is to collect and systematise the existing information regarding the "cup and ring cuttings" that have been observed on rocks and boulders in Europe and India, and to add to this systematised knowledge an account of those that are now known in America.

The first monograph on these archaic forms of sculpturings on rocks and stones was that of A. E. Holmberg, on the Lapidary Sculpturings of Scandinavia ("Skandinavien's Hällristningar," Stockholm, 1848), but though copiously illustrated, it remained in a great measure a sealed book, from its being written in Swedish; and it was not till the publication of Mr. Tate's memoir on "The Ancient British Sculptured Rocks of Northumberland and the Eastern Border" (Alnwick, 1865); the exhaustive essay on the same subject by the late Prof. Sir James Y. Simpson, entitled "Archaic Sculpturings of Cups, Circles, &c., upon Stones and Rocks in Scotland, England, and other Countries" (Edinburgh, 1867); and the larger work, prepared under the direction of the late Algernon Duke of Northumberland, entitled "Incised Markings on Stone found in the County of Northumberland, Argyle, and other Places, from Drawings made in the Years 1863 and 1864" (London, 1869) that the attention of archaeologists generally was awakened to the

¹ "Observations on Cup-shaped and other Lapidarian Sculptures in the Old World, and in America." By Charles Rau. (Washington, 1881.)